4.3.5 SUMMARY AND COMPARISON

Table 4-45 summarizes the environmental impacts of modifying SRP waste management activities with respect to new waste management facilities under each of the four strategies. This evaluation is detailed enough to include the potential impacts of each strategy. The No-Action strategy would continue potential significant environmental impacts to water resources, air, ecology, public health and socioeconomics, and has a potential need for dedication of land if contamination occurs by an uncontrolled release of waste. The No-Action strategy would not comply with environmental laws and regulations. However, no impacts would be expected in the areas of archaeological/historic resources, and noise. TE

For the period of evaluation [i.e., 120 years for the Dedication strategy (20 years of operation plus 100 years of institutional control), 20 years for the Elimination strategy (20 years of operation only), and 120 years or 20 years for disposal and storage under the Combination strategy], Table 4-45 indicates that no significant impacts would be expected from these strategies on water resources, air, ecology, public health, archaeological and historic resources, socioeconomics, and noise. However, beyond the 100-year institutional control period, releases of waste constituents could occur under various facility designs (e.g., no low-permeability cap, RCRA landfill rather than vault). DOE could revise such designs, mitigate the problem by removing or immobilizing the wastes, or demonstrate environmental compliance through an extended period of monitoring and postclosure maintenance.

The Dedication strategy and the disposal portion of the Combination strategy could require dedication of as much as 400 acres of land to waste management in perpetuity and possible postclosure care beyond the period of institutional control. Conversely, the Elimination strategy and the storage portion of the Combination strategy would require no direct dedication of land in perpetuity, but would require DOE to develop and implement the waste management technologies required to retrieve and treat or dispose of the stored waste.

4.4 STRATEGIES FOR DISCHARGING DISASSEMBLY-BASIN PURGE WATER

This section summarizes the radiological impacts associated with the strategies being considered for disassembly-basin purge-water discharges from C-, K-, and P-Reactors.

- No Action - Continued use of active reactor seepage and containment basins for discharge of disassembly-basin purge water.
- Dedication - Same as the No-Action strategy.
- Elimination - Evaporation of disassembly-basin purge water through commercially available equipment or direct discharge of the purge water to onsite streams.

- Combination - Continued discharge of disassembly-basin purge water to active reactor seepage and containment basins and continued evaluation of feasible tritium mitigation measures (e.g., reactor moderator detritiation). This section contains an analysis of detritiation to provide an estimate of costs and environmental impacts.

4.4.1 BACKGROUND

Reactor disassembly-basin purge water becomes contaminated with tritium (radioactive hydrogen isotope) and other radionuclides when fuel, targets, and other irradiated components are transferred to the disassembly basin from the reactor. Each irradiated assembly brings tritium oxide into the disassembly basin. The tritium oxide is dissolved in droplets of deuterium oxide (nonradioactive "heavy water") adhering to the surface and is also absorbed in the aluminum oxide cladding of the assembly. The tritium oxide dissolves in the disassembly-basin water and becomes distributed uniformly throughout the disassembly basin.

Disassembly-basin water is recirculated through deionizers and sand filters to remove radionuclides and to improve water quality. This process does not remove tritium, and small amounts of other radionuclides also remain in the water.

The disassembly-basin water must be purged periodically to keep tritium concentrations at safe levels for workers. During purges, fresh filtered water is added to the basin at the same rate contaminated water is purged from the basin through an ion-exchange system. The purge is not continuous but occurs at a frequency that depends on the type of reactor assemblies and the frequency of discharge operations. Typically, the reactor basins are purged twice yearly.

Preliminary groundwater monitoring data recently have identified the presence of volatile organic constituents in the vicinity of the C-Area seepage basin. Because these compounds are not introduced with the disassembly-basin purge water, investigations are in progress to identify their origin as well as the effect of continued use of the basin on their distribution in the groundwater. For evaluation purposes, however, these constituents are not considered because they are unique to the C-Area and must be managed on the basis of more specific evaluations than those employed herein, and because their presence does not affect the radiological doses used as a primary factor in the comparisons.

Table 4-46 lists the average annual and cumulative amount of tritium discharged from the reactor disassembly basins, which is the same for each strategy except the Combination strategy with detritiation. Values presented for 1987 to 2000 are based on annual release rates (Du Pont, 1984a). For 2001 to 2012, the release rates are assumed to be identical to those for 2000.

The amount of discharged tritium that ultimately reaches the environment depends on which strategy is implemented. Detritiation is the only method that would reduce the total discharge of this radionuclide. Others would simply alter the pathways through which discharged tritium could be accessible to the public.

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Table 4-46. Predicted Tritium Discharge from Reactor Disassembly Basins

Discharge alternative	Average annual release[a] (Ci/yr)	Cumulative release[a] (Ci)
Detritiation - Combination	4,000	103,000
Evaporation - Elimination	15,200	396,000
Direct discharge - Elimination	15,200	396,000
No Action - Combination, Dedication	15,200	396,000

[a]1987-2012.

Small amounts of radionuclides other than tritium remain in the disassembly-basin water at the time of purge. Annual and cumulative releases of these nuclides from reactor disassembly basins are listed in Table 4-47; these releases are assumed to be the same for each strategy.

Table 4-47. Annual and Cumulative Discharges of Non-tritium Radionuclides from Reactor Disassembly Basins[a] (Ci)

Radionuclide	Annual release (Ci)	Cumulative release[b] (Ci)
Phosphorus-32	3.6×10^{-3}	9.4×10^{-2}
Sulfur-35	2.9×10^{-2}	7.4×10^{-1}
Chromium-51	5.4×10^{-1}	1.4×10^{1}
Cobalt-58, 60	1.1×10^{-3}	2.9×10^{-2}
Strontium-89	2.1×10^{-4}	5.5×10^{-3}
Strontium-90	6.0×10^{-4}	1.6×10^{-2}
Yttrium-91	1.5×10^{-2}	4.0×10^{-1}
Zirconium-95	3.3×10^{-2}	8.6×10^{-1}
Ruthenium-106	1.0×10^{-3}	2.7×10^{-2}
Antimony-125	2.4×10^{-2}	6.2×10^{-1}
Iodine-131	2.1×10^{-2}	5.4×10^{-1}
Cesium-134	1.5×10^{-2}	4.0×10^{-1}
Cesium-137	1.3×10^{-1}	3.4
Cerium-144	5.7×10^{-2}	1.5
Promethium-147	8.4×10^{-3}	2.2×10^{-1}
Unidentified beta-gamma[c]	2.7×10^{-1}	6.9
Unidentified alpha[d]	9.6×10^{-4}	2.5×10^{-2}

[a]Adapted from DOE, 1984.
[b]1987-2012.
[c]Assumed to be strontium-90.
[d]Assumed to be plutonium-239.

Radiological doses were calculated for each year of the 26-year NUS study
TC period (1987-2012) for each strategy (using methods and parameters in NRC, 1977 and ICRP, 1978). Discussions for the various strategies in the following sections present the maximum doses for any single year and annual average values over the 26-year period.

Doses presented in this analysis are effective whole-body doses (EWBDs). EWBDs are calculated by summing doses weighted by their relative risk (ICRP, 1977). Throughout this analysis, the term "dose," as applied to individual EWBDs, represents a 50-year dose-equivalent commitment. The term "collective dose" refers to the 50-year dose equivalent received by the population that additionally incorporates the 100-year environmental dose-commitment concept.

The maximum individual dose is that received by an offsite individual whose location and habits maximize the dose.

Collective doses ("population doses") resulting from atmospheric releases have been calculated for the population projected to be residing within 80 kilometers of the SRP. Collective doses resulting from liquid releases include doses to the downstream water users who consume drinking water from the Beaufort-Jasper and Port Wentworth water-treatment plants (Du Pont, 1984a; DOE, 1984).

4.4.2 NO-ACTION STRATEGY (CONTINUATION OF DISCHARGE TO SEEPAGE BASINS)

With the No-Action strategy, the current practice of discharging disassembly-basin purge water to the C- and P-Area seepage basins and the K-Area containment basin would continue. Water discharged to the seepage basins would either evaporate or migrate to the groundwater, where it would be transported
TC to outcrop areas along surface streams. Groundwater transport of radionuclides other than tritium would be negligible.

Annual tritium releases to the environment calculated for the 26-year study period as described in Section 4.4.1 are shown in Table 4-48.

TE Radiation-induced health effects from releases under the No-Action strategy over the 26-year study period are calculated to total 0.029 excess fatalities.

Table 4-49 presents the highest annual and average annual EWBDs to the maximally exposed individual and the collective dose calculated over the 26-year study period.

The highest annual maximum individual dose of 0.047 millirem occurs in 1991 for the No-Action strategy; the annual average maximum individual dose is 0.04 millirem. These doses are about 0.05 percent or less of the DOE radiation protection standards. The average collective dose of 4.0 person-rem in 2012 is less than 0.004 percent of the exposure of about 103,000 person-rem to the population from natural radiation sources.

4.4.3 DEDICATION STRATEGY

The Dedication strategy is identical in concept to the No-Action strategy; that is, it continues disassembly-basin purge water discharges to active reactor seepage and containment basins.

Table 4-48. Tritium Releases to Environment Associated with the No-Action Strategy

Release pathway	Maximum annual release (Ci/yr)	Average annual release[a] (Ci/yr)	Cumulative release[a] (Ci)
Atmospheric	6,100[b]	4,570	119,000
Liquid	8,850[c]	7,110	185,000
Combined	13,200[d]	11,700	304,000

[a]1987-2012.
[b]The maximum annual atmospheric tritium release occurs during the years 1987 through 1989.
[c]The maximum annual liquid tritium release occurs in 1991.
[d]This number represents the highest annual total tritium release through the atmospheric and liquid pathways combined, which occurs in 1991, and is not the sum of the maximum annual atmospheric and liquid releases; this release occurs in 1991. TC

Table 4-49. Highest Annual and Average Annual EWBD Associated with the No-Action Strategy

Receptor/exposure pathway	Highest annual dose[a]	Average annual dose[a]
Maximally exposed individual (mrem/year)		
Atmospheric	0.009	0.01
Liquid	0.038	0.03
Total	0.047[b]	0.04
Population (person-rem/year)		
Atmospheric	0.38	0.35
Liquid	4.94	3.70
Total	5.32[c]	4.05

[a]1987-2012.
[b]The highest annual maximum individual dose occurs in 1991.
[c]The highest annual collective dose occurs in 2012.

4.4.4 ELIMINATION STRATEGY

The Elimination strategy, as applied to the management of disassembly-basin purge water, includes either evaporation to the atmosphere or direct discharge of the purge water to onsite surface streams.

With evaporation, all disassembly-basin purge water is assumed to be evaporated to the atmosphere, as described in Section 2.4. Tritium would be the only radionuclide released to the atmosphere, because all others would be retained in the evaporator. The only liquid releases would be from residual seepage of tritium released to the seepage basins earlier. The seepage of nontritium radionuclides is negligible.

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Annual tritium releases to the environment (atmospheric and liquid pathways) were calculated for the 26-year study period as described in Section 4.4.1. Table 4-50 presents the maximum and average annual tritium releases to the environment, as well as the cumulative tritium release for the 26-year study period.

Table 4-51 presents the highest annual and average annual EWBDs to the maximally exposed individual and the collective dose calculated over the 26-year study period.

The highest annual maximum individual dose of 0.074 millirem occurs in 1989 for the Elimination strategy with evaporation, and the annual average maximum individual dose is 0.041 millirem. These doses are about 0.1 percent or less of the DOE radiation protection standards. The average annual collective dose of 1.67 person-rem in 1989 is less than 0.002 percent of the exposure of about 103,000 person-rem to the same population from natural radiation sources.

Table 4-50. Tritium Releases to Environment Associated with the Elimination Strategy (Evaporation)

Release pathway	Maximum annual release (Ci/yr)	Average annual release[a] (Ci/yr)	Cumulative release[a] (Ci)
Atmospheric	20,300[b]	15,230	396,000
Liquid	7,570[c]	1,910	49,700
Combined	27,400[d]	17,100	446,000

[a]1987-2012.
[b]The maximum annual atmospheric tritium release occurs annually during the years 1987 through 1989.
[c]The maximum annual liquid tritium release occurs in 1990.

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[d]This number represents the highest annual total tritium release through the atmospheric and liquid pathways combined, which occurs in 1989, and is not the sum of the maximum annual atmospheric and liquid releases; this release occurs in 1989.

Radiation-induced health effects from releases under the evaporation alternative over the 26-year study period are calculated to total 0.012 excess fatality.

Radiation-induced health effects from releases under the direct discharge alternative over the 26-year study period are calculated to total 0.068 excess fatality.

Table 4-51. Highest Annual and Average Annual EWBDs Associated with the Elimination Strategy (Evaporation)

Receptor/exposure pathway	Highest annual dose[a]	Average annual dose[a]
Maximally exposed individual (mrem/yr)		
Atmospheric	0.044	0.033
Liquid	0.030	0.008
Total	0.074[b]	0.041
Collective (person-rem/yr)		
Atmospheric	1.41	1.17
Liquid	1.56	0.51
Total	2.96[b]	1.67

[a]1987-2012.
[b]The highest annual maximum individual and collective doses occur in 1989.

Direct Discharge

With direct discharge, all disassembly-basin purge water would be discharged directly to surface-water streams. In addition, residual seepage of tritium to surface water from seepage basin use prior to the initiation of this alternative would contribute to liquid releases.

Annual tritium releases to the environment (atmospheric and liquid pathways) were calculated for the 26-year study period as described in Section 4.4.1. TC

Table 4-52 presents the maximum and average annual tritium releases as well as the cumulative tritium release to the environment. Radionuclides other than tritium in the disassembly-basin purge water (presented in Table 4-47) are assumed to be released directly to onsite streams.

Table 4-53 presents the highest annual and average annual EWBDs to the maximally exposed individual and the collective dose calculated over the 26-year study period.

The highest annual maximum individual dose of 0.204 millirem occurs in 1989 for the direct discharge, and the annual average maximum individual dose is 0.16 millirem. These doses are about 0.2 percent or less of the DOE radiation protection standards. The average annual collective dose of 9.4 person-rem is less than 0.009 percent of the exposure of about 103,000 person-rem to the same population from natural radiation sources.

Table 4-52. Tritium Releases to Environment Associated with the Elimination Strategy (Direct Discharge)

Release pathway	Maximum annual release (Ci/yr)	Average annual release[a] (Ci/yr)	Cumulative release[a] (Ci)
Atmospheric	0	0	0
Liquid	27,400[b]	17,100	446,000
Combined	27,400[b]	17,100	446,000

[a]1987-2012.
[b]The maximum annual liquid tritium release occurs in 1989.

Table 4-53. Maximum and Average Annual EWBDs Associated with the Elimination Strategy (Direct Discharge)

Receptor/exposure pathway	Highest annual dose[a]	Average annual dose[a]
Maximally exposed individual (mrem/year)		
Atmospheric	0	0
Liquid	0.204	0.16
Total	0.204[b]	0.16
Collective (person-rem/year)		
Atmospheric	0	0
Liquid	12.1	9.40
Total	12.1[c]	9.40

[a]1987-2012.
[b]The highest annual dose to the maximum individual occurs in the year 1989.
[c]The highest annual collective dose occurs in 2012.

4.4.5 COMBINATION STRATEGY

The Combination strategy includes the continuation of disassembly-basin purge water discharges to active reactor seepage and containment basins while DOE continues to assess tritium-mitigation measures such as reactor moderator detritiation. Other mitigation measures are discussed in Section 4.8.

The consequences of the continuation of discharging purge water to active seepage basins are discussed in Sections 4.4.1 and 4.4.2.

Detritiation of the reactor moderator in a central facility has been considered for all SRP reactors. A moderator detritiation plant (MDP) would be expected to reduce equilibrium moderator tritium levels by a factor of about 10. The moderator is the source of the tritium that contaminates the disassembly-basin water, so a corresponding reduction in disassembly-basin purge water tritium concentrations and releases from this source would be expected.

Water discharged to the seepage basins would either evaporate, carrying tritium with it to the atmosphere, or move down to the groundwater, where it would be transported laterally to outcrop areas along surface streams.

The nontritium radionuclides (see Table 4-47) would seep into the ground and experience radioactive decay and retardation by adsorption (DOE, 1984). These processes would reduce nontritium releases to surface waters to insignificant levels.

Tritium would move with the groundwater and undergo radioactive decay during travel to surface outcrops. The amount of tritium expected to be released from the seepage basins has been calculated assuming that 30 percent of tritium released to the basins evaporates and that the remaining 70 percent migrates to streams while undergoing radioactive decay.

Radiation-induced health effects from releases over the 26-year study period are calculated to total 0.014 excess fatality.

Average annual collective EWBDs within the defined impact areas (80-kilometer radius and downstream Savannah River water users) associated with the alternative strategies range from about 1.7 person-rem with evaporation to 9.4 person-rem with direct discharge. These doses to the affected population are a small fraction of the naturally occurring background doses to the same population.

The half-life of tritium (12.3 years) will result in doses to individuals beyond the defined impact areas, particularly for atmospherically released tritium from evaporation. Although minuscule, these doses can be summed through a much larger population (e.g., the U.S. population or the world) to arrive at hypothetical collective doses significantly greater than those for evaporation presented in Tables 4-51 and 4-54 (although still an insignificant percentage of the naturally occurring dose to the same population). However, this approach to dose assessment is not recommended by national and international radiation standards organizations as a basis for judging alternative radiation protection practices. Although this type of collective dose has not been calculated for this EIS, atmospheric discharge of tritium can contribute substantially greater theoretical collective doses per curie released than do liquid discharges at the SRP, with correspondingly greater (although still insignificant) health effects. TC

4.4.6 COMPARISON OF ENVIRONMENTAL CONSEQUENCES

When compared with no action, detritiation would decrease the total tritium released to the environment from the reactor seepage basins by a factor of about 2, while the total tritium released from evaporation and direct discharge would increase from no action. TC

Table 4-54. Average Annual EWBD to the Maximally Exposed Individual for Each Strategy (mrem/yr)

		Elimination		Combination/ Dedication
Exposure pathway	Combination Detritiation	Evaporation	Direct discharge	No Action
Atmospheric	0.004	0.033	0.000	0.010
Liquid	0.018	0.008	0.160	0.030
Total	0.022	0.041	0.160	0.040

The average annual effective whole-body dose received by the maximally exposed individual for each strategy is presented in Table 4-54. The doses range from 0.022 millirem per year for detritiation to 0.16 millirem per year for direct discharge and represent small fractions of the 93 millirem per year received by an individual from natural background radiation (DOE, 1984).

Average annual collective EWBDs associated with the various strategies range from about 1.7 person-rem per year with evaporation to 9.4 person-rem per year with direct discharge. The average annual collective EWBD for detritiation is 1.87 person-rem per year. The dose associated with natural background radiation delivered to the same population would be 103,000 person-rem per year. Collective doses associated with each strategy, therefore, represent less than 0.01 percent of the dose received from natural background radiation. The corresponding health effects and doses are not significant.

The cost benefit of detritiation would be more than $3 million per person-rem averted, compared to no action. The average annual cost benefit of the evaporation would be about $500,000 per person-rem averted, compared to no action. There would be little difference in the cost of implementing direct discharge and the No-Action strategy for discharge of DBPW. The cost benefits of these tritium management strategies were calculated from the capital and operating costs given in Tables 2-11 and 2-12 and from the EWBDs given above.

4.5 ACCIDENTS

The environmental impacts and risk of potential accidents associated with closure have been analyzed for each of the individual waste sites used for the disposal of hazardous and radioactive materials. The selected closure action would be implemented in such a manner that the risk to the public from accidental releases of materials from the site would be minimal.

The potential accidents and consequences associated with each action for each waste site are related to the materials at the site. The potential accident scenarios are based on the processes proposed to be used and the hazards associated with these materials.

Several of these events are defined to include spillage of waste from a steel box. These boxes are ruggedly constructed and difficult to breach. It was not considered cost-effective or necessary to analyze the structure of the box to determine under what conditions it would fail, because the consequences of such an event were judged to be relatively minor. The probability of box failure in an accident was assumed conservatively to be 0.25.

The accident scenarios considered are natural events such as tornadoes, hurricanes, floods, and earthquakes, and industrial accidents such as falls, fires, cave-ins, and container spills. The natural events were analyzed using historical data on probability and severity. Industrial accidents were analyzed using labor-hour estimates based on commercial cost-estimating handbooks and industrial accident rate tabulations. The number of workdays of construction labor required to accomplish the waste-removal and no-waste-removal options was estimated. This estimate was used to calculate the probability of each potential accident. The major accident types are described below. (Palmiotto, 1986, provides further explanations for each accident.)

- Tornado. The major effect of a tornado would be entrainment of dust laden with contaminants, with possible dispersion off the waste site. Dispersal could occur during the excavation activities.

- Hurricane and high straight wind. If high winds occur during excavation of the waste sites, there is the potential for pickup and dispersal of waste-site contaminants.

- Flooding. Flooding of a waste site during closure options was dismissed from consideration because of the location of the waste sites, and because the level of the Savannah River is controlled by three major hydroelectric dams upstream from the sites. In addition, measures would be taken on the SRP to prevent flooding during heavy rains.

- Earthquake. The only effect of an earthquake pertinent to this analysis is the failure of a berm or dike at the waste site or during excavation of a site. During excavation operations, such an accident could result in injuries and equipment damage. An unusually heavy rain could leave water in a site, but the combined probability of such a rain and a major earthquake is exceedingly small. Dikes are estimated to fail in a MM IX earthquake, which has a frequency of occurrence estimated to be less than once in 10,000 years. If the earthquake were to occur while men were in an excavation trench, a cave-in could result in personnel injuries or fatalities.

- Industrial accident. The likelihood of personnel injuries through an industrial accident was evaluated by applying published accident rates to the number of labor-hours required for each closure option. The labor estimates were developed from the quantification of each activity required for a closure, such as the number of cubic meters of earth to be removed, the number of square meters of land to be leveled and seeded, and the number of meters of fence to be constructed. The source of data for this analysis was the background information prepared for preliminary cost estimates for each waste site and includes standard project estimating guides.

- Fire. Two causes of fire were considered: a natural forest fire, and an industrial fire initiated by material being excavated or by equipment used for site closure. The former fire has been dismissed as a concern because the forests on the Plant are managed, and controlled burning of underbrush is conducted. The SRP firefighting team would be able to protect material at an excavation site from an adjacent fire. Fires associated with fuel or hydraulic fluid occasionally occur with heavy construction equipment. This event is analyzed because dispersal of waste or employee injury could occur. Fire initiated in an excavation or by excavating equipment could easily be smothered by readily available equipment.

- Explosion. No explosive materials were identified on the waste sites or in adjacent areas. Therefore, explosion as an accident initiator was dismissed.

- Container puncture. This accident initiator applies to sites where drums are stored. During excavation these units could be punctured, potentially spreading contamination. Puncture of a unit containing soil or sediment removed from the basin is discussed under other scenarios.

- Equipment collision. A collision of mobile heavy equipment could occur on any construction site. This scenario includes collisions involving any of the mobile equipment onsite (i.e., trucks, forklifts, and front-end loaders) and also covers waste-box punctures.

- Toppling of large equipment. Large excavation equipment such as draglines and backhoes could be used for closure of a site. A check of construction industry accident statistics revealed that relatively major accidents with such equipment occur often enough that they should be considered. This accident is defined to include such events as dragline structural failure, cable breaks, and grade cave-in resulting in the toppling of a backhoe or dragline.

- Employee injury during construction. During any excavation and heavy construction project of this size, there would be some employee injuries, almost all nonfatal. This scenario includes nonfatal accidents such as falls, equipment-related injuries to hand or eyes, and minor burns.

- Operator contamination. This includes any contamination to workers by exposure to or contact with hazardous materials contained on the site during closure activities.

* Waste box drop and breach. During excavation, the contaminated soil and sediment would be placed in steel boxes for transportation to a storage or disposal area. Some waste boxes could be dropped during handling by forklifts or cranes. This event is defined to include only drops that result in a breach of the box, either by puncture or by opening of its lid. Employee injuries are excluded.

* Cave-in. During excavation and closure, workers must enter the waste sites to perform tests, rig equipment, and excavate the sediment and soils. Cave-ins are a possible cause of injuries and fatalities to construction workers.

* Truck accident and fire. This includes a truck accident and fire when waste is being transported to the storage and disposal areas.

* Truck accident and spill. This includes a truck accident in which the waste box is breached or opened, resulting in spillage of waste materials.

* Truck accident and fatality. A certain percentage of truck accidents result in operator fatalities. This scenario includes truck accident fatalities during the transportation of waste materials to storage and disposal areas.

* Fall of box from truck. This includes a waste box falling from a truck during transit due to rigging or driving errors, resulting in spillage of contents.

Table 4-55 summarizes the accidents described above, including the initiator and the consequence. Risks were calculated for certain accidents in which the consequences allowed such an assessment to be made; these occurrences are (1) employee injury, (2) truck accident and fatality, and (3) fatal construction accident. The results of these assessments are presented in Tables 4-56 through 4-59 for each site for the no-action, no-waste-removal-and-closure, complete-waste-removal and closure, and selected-waste-removal strategies, respectively.

4.6 DECONTAMINATION AND DECOMMISSIONING

The proposed new facilities ultimately would require decontamination and decommissioning. Decontamination and decommissioning of the proposed facilities would be included in an overall site decontamination and decommissioning plan, which would be subject to environmental and public review before implementation.

Three basic decommissioning methods are defined: DECON, ENTOMB, and SAFSTOR (Calkins, 1980). DECON involves the immediate removal of all radioactive materials to levels that are considered acceptable to permit the property to be released for unrestricted use (NRC, 1981). Chemical decontamination of the structure and the internals would be followed by the dismantling, transportation, and burial of the internals. As the final step, the outer structure would be demolished and the site restored to its precommissioning status.

Table 4-55. Closure Accidents

Initiator	Accident	Consequence
Tornado	High winds disperse soil	Minimal dispersion of soil at waste site but not beyond SRP boundary; potential serious personnel injury
Straight wind	High winds disperse wet soil	Minimal dispersion of wet soil onsite, none offsite
Earthquake	Failure of excavation site (basin walls, berms, etc.)	Minimal dispersion of soil onsite; potential personnel injury
Container puncture	Waste containers at site	Loss of contents at site; cleanup initiated (Gunsite 720 rubble pit) A few suspected empty containers at site; no probable impact (hydrofluoric acid spill area)
Equipment collision	Mobile equipment collides; possible puncture of waste containers	Releases (where applicable) confined to the immediate area of the site; possible personnel injury
Failure of equipment	Large equipment toppling	Dispersion of waste material at site; possible personnel injury
Fall/equipment-related injuries	Employee injury	Minor personnel injury
Contamination	Inadvertent contamination to workers at site	Minor contamination; immediate decontamination; minor personnel injury
Drop and breach	Waste container dropped and puncture or lid opening occurs	Release of waste at site; cleanup initiated; minor or no personnel injury
Equipment fire	Fuel or hydraulic fuel catches fire	Minor personnel injury; damage to equipment

Table 4-55. Closure Accidents (continued)

Initiator	Accident	Consequence
Cave-in	During excavation of material with equipment	Personnel injury or possible fatality
Accident and fire	Accident resulting in fire	SRP fire department response; minimum personnel injury; damaged equipment
Accident and spill	Truck accident during transport; waste container damaged and breached	Waste release confined to accident site; cleanup initiated
Accident and fatality	Truck accident while in transit to disposal area	Fatality to driver
Fall of box from truck	Rigging or driving errors result in spillage of waste container contents	Release of waste at site of accident; cleanup initiated
Truck accident	Truck with fill and another vehicle collide, or single vehicle accident occurs	Potential personnel injury; material released at accident site; cleanup initiated
Fatal construction accident	Construction accident	Fatality

ENTOMB is the encasement of the facility in a material possessing long-lived structural integrity until a time when the dose level is amenable to unrestricted use. This would be the method used for sites where the radioactivity would decrease to acceptable limits within a reasonable time. A reasonable time period for ENTOMB is approximately 100 years (NRC, 1981).

SAFSTOR involves placing a facility and equipment in temporary storage within acceptable risk levels for subsequent decontamination and unrestricted facility use. SAFSTOR has six major phases:

- Chemical decontamination
- Mechanical decontamination and fixing of residual radioactivity
- Equipment deactivation
- Preparation for interim care
- Interim care (surveillance and maintenance)
- Final dismantling

In demolition and restoration, all above-grade portions of the plant structures would be demolished by conventional methods, such as explosive and impact balls. The site would then be graded and revegetated.

Pending the results of further studies and reviews, decommissioning of the proposed facilities and equipment is expected to be conducted via SAFSTOR. Startup of the proposed new facilities would be spread over time, as would future decontamination and decommissioning.

Impacts from decontamination and decommissioning would be very small. Projections of these impacts specific to the proposed facilities and equipment have not been made; estimates, however, have been prepared (Manion and LaGuardia, 1976) for the decontamination and decommissioning of commercial power reactors of pressurized-water-reactor (PWR) design. The estimated dose to a member of the public for the DECON option was 3.0×10^{-5} millirem per year (lung) during the period of the decontamination and decommissioning operation. Both ENTOMB and SAFSTOR were projected to result in even lower doses.

The proposed new facilities would handle only low-level radioactive, hazardous, and mixed wastes. These proposed facilities are:

1. Low-level radioactive waste storage/disposal facility
2. Hazardous and mixed wastes storage/disposal facilities (TE)
3. Cement/flyash matrix storage/disposal (Y-Area)

4.7 CUMULATIVE EFFECTS

Cumulative effects are discussed in the following sections for the alternative waste management strategies described in Section 2.1, in conjunction with the effects of existing and planned facilities at or near the Savannah River
TE Plant. The discussion is based on an analysis of a range of environmental impacts to provide minimum and maximum cumulative effects.

4.7.1 EXISTING AND PLANNED FACILITIES

4.7.1.1 Facilities Near SRP

Eight facilities located within 16 kilometers of the Savannah River Plant are included in the cumulative effects analysis. These include the Vogtle Electric Generating Plant of Georgia Power Company, directly across the Savannah River from the SRP; the Chem-Nuclear Services, Inc., plant in Barnwell County, South Carolina, east of the SRP; and RCRA and CERCLA sites in South Carolina, as listed in Table 4-60.

The Vogtle Electric Generating Plant is a two-unit nuclear powerplant under construction. Unit 1 was licensed to operate at full power by the Nuclear Regulatory Commission in May 1987. Chem-Nuclear Services, Inc., operates a low-level radioactive waste burial ground.

Table 4-60. RCRA and CERCLA Sites in South Carolina

Name	City	County	Direction from SRP
		CERCLA	
Admiral Home Appliances	Williston	Barnwell	East-northeast
Barnwell Seed & Supply	Barnwell	Barnwell	East
Barnwell Town Dump	Barnwell	Barnwell	East
Kimberly-Clark Corporation	Beech Island	Aiken	Northwest
Simpkins farm site	Beech Island	Aiken	Northwest
		RCRA	
Sandoz, Incorporated	Martin	Allendale	South

4.7.1.2 Effluent Treatment Facilities at SRP

The M-Area liquid effluent treatment facility (LETF) was designed and constructed to treat liquid effluents from the fuel and target fabrication facility. The facility eliminates the use of the M-Area settling basin. The LETF includes a chemical transfer facility, a dilute effluent treatment facility, process modifications for rinsewater reduction, and temporary storage tanks. Treatment includes physical-chemical treatment, precipitation, solids separation, evaporation, filtration, and neutralization. The treated liquid effluent from this treatment facility, which meets NPDES discharge limits, is discharged to Tims Branch.

The M-Area LETF was constructed adjacent to existing M-Area facilities in a developed and controlled area on a grassy site. Temporary construction impacts such as noise, dust, and fumes were controlled to minimal levels. Required permits for construction of this wastewater-treatment facility were issued. No adverse effects are expected to impact SRP wildlife, wetlands, or archaeological sites due to LETF construction or operation. Operation of the facility began in the spring of 1985. The sludges from the LETF are stored temporarily in new tanks in M-Area. A spill prevention control and countermeasure (SPCC) plan has been established.

F- and H-Area Effluent Treatment Facility

The F- and H-Area effluent treatment facility (ETF), located in H-Area, would be designed, constructed, and operated to store and treat routine wastewater and spills from the chemical separations facilities in F- and H-Areas. Operation of this new facility will eliminate the present discharge of these effluents to the F- and H-Area seepage basins (DOE, 1986). Current planning calls for startup of the facility following the closure of the seepage basins in November 1988. The facility would provide improved treatment of routine process effluents and contaminated cooling or storm water. Unit treatment processes consist of two stages of filtration, including iron removal and carbon filtration; reverse osmosis; neutralization; and ion exchange; with TC combined evaporation of filter backwash, reverse-osmosis reject streams, and ion-exchange regeneration waste. Recycling of evaporator overheads and treated effluent that exceeds discharge limits is included. Dewatered solids from the coarse filtration step would be disposed of in the burial ground or in the Y-Area facility (CMF). Evaporator bottoms (waste concentrate) would be transferred to the H-Area waste tank farm. Tritium is not removed in the treatment process. The estimated discharge of 30,000 curies per year from the ETF into Upper Three Runs Creek would be partially offset by decreases in atmospheric releases and tritiated groundwater outcrops due to closure of the F- and H-Area seepage basins (DOE, 1986). Storage basins are provided to contain large flows of contaminated cooling water or storm water.

TC

TNX-Area Effluent Treatment Plant

This facility is scheduled to begin operation in early 1988; it is designed to treat small-volume nonradioactive process effluents for NPDES discharge. The treatment processes include flow equalization, neutralization, and solids removal. Filter cake would be disposed of in the SRP sanitary landfill.

4.7.1.3 Waste Treatment, Storage, or Disposal Facilities at SRP

TC

Consolidated Incinerator Facility

An incinerator would be designed and constructed to incinerate a variety of hazardous wastes (e.g., contaminated soil, sludges, and liquid and solid wastes). The incinerator would consist of a primary rotary kiln, a secondary combustion chamber, and an off-gas treatment system including evaporative coolers and particulate and chloride removal systems. The process would allow simultaneous destruction of solids and aqueous and organic liquid wastes. Plans call for upgrading the incinerator to permit mixed waste incineration.

Hazardous Waste Redrumming Facility

EPA and the South Carolina Department of Health and Environmental Control (SCDHEC) require redrumming hazardous wastes contained in leaking or inadequate drums to comply with current RCRA regulations. This facility would be used to:

- Transfer liquid hazardous waste from leaking 208-liter drums to other drums
- Overpack 208-liter drums using 314-liter drums
- Transfer liquid hazardous waste from 208-liter drums and overpack into 314-liter drums
- Solidify liquid hazardous waste with absorbent
- Compact used drums with a crusher, and overpack in 314-liter drums
- Provide space for interim material handling storage

No radioactive releases are expected. Leaks, spills, or other liquids would be contained, collected, and processed. Activated carbon filters would absorb organic vapors from the facility exhaust air before venting the air to the atmosphere. TE

Cement/Flyash Matrix (Y-Area) Waste Storage/Disposal Facility

Y-Area will be designed to store, treat, and dispose of 4400 cubic meters of waste per year. The waste, very low in radioactivity, will be the concentrate from several effluent-treatment facilities. Facilities contributing to this waste load are M-Area, the F- and H-Area effluent treatment facility, the Fuel Materials Facility, and the Fuel Production Facility. In addition, beta-gamma and hazardous waste incinerator residues may also be disposed of in this facility.

The waste salt solutions and precipitated solids will be solidified in a cement/flyash or cement/slag matrix, similar to saltstone. Blast furnace slag is being considered in place of flyash due to its unique chemical reducing properties that would immobilize chromium. The alternative process being considered for disposal of this waste would containerize the dry waste salts in packages with structural properties for disposal in the mixed waste disposal facility. TC

Environmental emissions or releases are expected to be below applicable standards, due to disposal in CFM vaults or the mixed-waste disposal facility.

Z-Area Saltstone Disposal Facility

The Z-Area disposal facility is designed for disposal of both low-level radioactive and hazardous wastes, specifically partially decontaminated salt solution resulting from processing of high-level radioactive liquid wastes in the Defense Waste Processing Facility (DWPF). The solution contains sodium chromate and has a high pH, both of which cause the solution to be characterized as hazardous under SCDHEC regulations. The partially dewatered salt solution would be mixed with cement and water, or other media, to form a relatively nonleachable solid monolith saltcrete, suitable for long-term disposal in permitted vaults. TC

4.7.1.4 Other Facilities at SRP

Defense Waste Processing Facility

The DWPF is being constructed to process high-level radioactive liquid wastes currently stored as insoluble sludges, precipitated salt, and supernatant liquid in single or double tanks in the F- and H-Area tank farms. The process includes the removal of wastes from tank storage; immobilization of the high-level sludge and recovered cesium, strontium, and plutonium in borosilicate glass; encapsulation of the waste and glass mixture in steel canisters; storage of the canisters in a surface facility until shipment to a repository; and processing of the decontaminated salt into saltcrete monoliths (See discussion of Z-Area above). TC

Fuel Materials Facility

The Fuel Materials Facility (FMF) has been designed and constructed and would be operated to provide a second source of fuel materials employing enriched uranium for the Nuclear Navy Propulsion Program. The facility is located within F- and H-Areas. Air emissions would be controlled through the total containment concept, which consists of air locks, forced air circulation, enclosures and hoods on cabinets, high efficiency particulate air (HEPA) filters, and exhaust stack capability.

Liquid wastes include process recovery and laboratory effluents, sanitary wastes, cooling-system blowdown, and steam condensates. Process wastes would be neutralized, evaporated, mixed with concrete, and encapsulated in steel containers for burial in the SRP burial ground. Solid, low-level radioactive wastes would be placed in the SRP burial ground.

Fuel Production Facility

Construction of the Fuel Production Facility (FPF) was planned to begin in December 1986. The process involved, using an onsite uranium recycle process and powder metallurgy, would replace the current casting and machining process used to form fuel billet cores.

Solid wastes from the facility containing trace amounts of uranium, including rags, plastic bags, and gloves, would be disposed of in the burial ground or incinerated. The volume of solid waste is expected to be less than that generated by the current process.

Liquid chemical wastes such as acids or caustics from the process would be treated in the F- and H-Area ETF (see Section 4.7.1.2). Air emissions would be multiple HEPA-filtered.

Tritium-Loading Facility

This facility, also called the Replacement Tritium Facility, is designed to replace and upgrade some of the tritium processing and loading functions in the present tritium-loading facility. Construction is underway, and the
TC facility is scheduled to be completed in 1990.

Routine operation of the new facility would substantially reduce atmospheric releases. Tritium-contaminated solid waste generation and storage/disposal rates are expected to decrease. Mercury would be eliminated in the new process, thus eliminating storage and disposal needs for mercury-contaminated wastes. There would be no releases of liquid effluents to onsite streams or to groundwater. A beneficial cumulative impact in the reduction of radioactive releases and consequent offsite doses to the public is anticipated.

4.7.1.5 Demonstration Facilities at SRP

Among the demonstration facilities active or planned at the SRP are the following:

TC
- Abovegrade operation
- Beta-gamma incinerator
- Box/drum compactor
- Greater confinement disposal

Abovegrade Operation (AGO)

This one-year demonstration facility is designed to store solid low-level radioactive wastes over existing filled waste trenches in the SRP burial ground. The waste would be placed in stackable rigid containers on composite clay and gravel storage pads. The waste would be covered with sand, a puncture-resistant fabric, an impermeable cover, and finally a clay cover. There would be no atmospheric or solid waste releases from the site. Liquid releases would be monitored. The impermeable barriers would reduce rainwater percolation into the wastes or into the underlying waste trenches.

Beta-Gamma Incinerator TC

This demonstration facility is designed to incinerate low-level radioactive waste in both liquid and solid forms. The process has two stages, using an air-deficient pyrolysis chamber at 900°C followed by an 1100°C afterburner operating in excess air. Also included in the design is a spray quench tower and HEPA filter. Capacity of the incinerator is 181 kilograms per hour of solids or 1500 liters per hour of liquid wastes.

Box-Drum Compactor

This demonstration facility is designed to handle solid low-level radioactive wastes by compaction, reducing waste volumes by factors of 4 or 5 to 1. Following compaction, the wastes would be placed in 1.2-meter by 1.2-meter by 1.8-meter steel boxes for disposal in the low-level burial ground. Environmental releases from the facility are expected to be insignificant. There are no liquid releases. HEPA filters would remove and retain radioactive particulates from the facility ventilation/exhaust air system. TC

Greater Confinement Disposal

The GCD demonstration is designed to dispose of low-level radioactive wastes in lined 9-meter-deep auger holes or in short trenches with vertical walls. The wastes (in rigid containers) or contaminated metallic objects would be stabilized in place with self-leveling grout. The facilities would be capped when filled. The potential for leachate generation is small due to the presence of grout and the cap. Monitoring of leachate is included in the design. TC

4.7.2 GROUNDWATER

4.7.2.1 Groundwater Withdrawal

The withdrawal of groundwater from the Middendorf/Black Creek (Tuscaloosa) aquifer in support of existing and projected SRP operations is not expected to affect offsite water levels in the aquifer (DOE, 1984). However, as discussed in Section 4.2.1, the groundwater withdrawal in support of remedial actions at the existing waste sites could physically impact the water table outside the SRP boundary. Careful monitoring of the water table during startup of any remedial action would determine if there are impacts to the water-table aquifers.

The offsite facilities identified in Section 4.7.1.1 are not expected to contribute to the SRP's withdrawal rate and its associated drawdown. The Vogtle

Nuclear Plant withdraws groundwater from areas unaffected by the SRP. The offsite facilities are not expected to contribute to the SRP's withdrawal rate and any associated drawdown.

4.7.2.2 Groundwater Quality

The groundwater quality under the Plant would be improved as a result of the implementation of the Elimination alternative strategy. The remedial actions would be such that the groundwater quality from one area of the SRP would not adversely impact the groundwater in another.

Based on apparent groundwater-flow direction, groundwater from beneath the Vogtle Nuclear Plant, the Kimberly-Clark Corporation, the Simpkins farm, Barnwell Seed and Supply, the Barnwell Town Dump, and the Admiral Home Appliance site does not appear to come in contact with the groundwater from beneath the other facilities identified in Section 4.7.1, or the groundwater affected by the SRP. Therefore, these facilities should not contribute to the cumulative impact on groundwater quality.

The new retrievable-storage facilities, the ETFs, the other operating facilities, and the demonstration facilities would be designed and constructed so that they do not release contaminants to the groundwater. These facilities would be properly maintained and would not contribute to a cumulative impact on groundwater quality.

TC Under the No-Action strategy, the quality of the groundwater under the SRP would continue to be affected.

4.7.3 SURFACE WATER

4.7.3.1 Surface-Water Use

The Chem-Nuclear Services facility, the CERCLA sites, the Sandoz, Inc., RCRA site, the new disposal facilities, the ETFs, the waste treatment, storage, or disposal facilities, the other operating facilities, and the demonstration facilities are not expected to use surface water from the Savannah River. The Vogtle Nuclear Plant withdraws a few cubic meters per second from the river for use as cooling-system makeup water, a portion of which would be returned as blowdown. The SRP is estimated to withdraw 37 cubic meters per second, while the average flow of the Savannah River is 285 cubic meters per second (DOE, 1984). Under average conditions, the cumulative surface-water use is projected to be about 14 percent of the Savannah River, compared to 13 percent for the SRP alone. In addition, the major portion of this withdrawal is used for cooling water and is returned to the river via onsite streams. Thus, the cumulative impact is not expected to be significant.

TC 4.7.3.2 Surface-Water Quality

Existing waste sites would be remediated so that contamination from these sites does not adversely affect surface-water quality. The new retrievable-storage facilities, the ETFs, the other operating facilities, and the demonstration facilities would be designed, constructed, operated, and maintained so that discharges would not adversely impact surface-water quality. The

Vogtle Nuclear Plant has been designed, constructed, and will be operated and maintained so discharges do not adversely impact surface-water quality.

Any potential contamination from the Admiral Home Appliances, the Barnwell Seed and Supply, and the Barnwell town dump CERCLA sites is expected to enter the Salkehatchie River watershed and should not be expected to contribute to cumulative impacts on the Savannah River. | TC

Any potential contamination from the Kimberly-Clark Corporation and the Simpkins farm CERCLA sites probably enters the Savannah River above the SRP. Considering the groundwater flow rates in this area, the contamination would take more than 100 years to reach the Savannah River and is not expected to contribute significantly to the water quality of the river. | TE

There are no liquid discharges from the Chem-Nuclear Services facility to contribute to the cumulative effects on surface-water quality.

Under the No-Action strategy, the quality of surface streams on the SRP would continue to be affected as a result of existing waste sites. The other facilities identified in Section 4.7.1.1 are not expected to contribute to the cumulative impact on surface-water quality.

4.7.4 HEALTH EFFECTS

4.7.4.1 Exposure to Radioactive Substances

The evaluation of health effects has considered cumulative effects from the operation of all nuclear facilities on and in the vicinity of the SRP. These facilities consist of four production reactors with associated support facilities; hazardous, low-level, and mixed waste sites; and planned operations at the SRP, including the ETF, the DWPF, the FMF, and the FPF. The Vogtle Electric Generating Station and the Chem-Nuclear Services, Inc., low-level radioactive disposal site are also included in the evaluation of the cumulative health effects. The risk estimator used to project health effects is 280 cancers and genetic effects per 1 million person-rem of collective dose. | TC

Existing Waste Sites

Using the risk estimator mentioned above and the cumulative doses presented in Appendix H, Table 4-61 lists the cumulative health effects that could be experienced by the population from radiation received in the year 2000 for the No-Action strategy and during the first year after implementation of the other three strategies. Remedial actions at the waste sites were not considered in calculating these health effects. The recipient population of the air component of the health effects is assumed to lie within an 80-kilometer radius of the SRP. The recipient population of the liquid component of the health effects is assumed to be the Savannah River water users downstream from the SRP. | TC

New Retrievable-Storage Facilities

The changes in health effects that could be imparted to the water user population downstream from the SRP due to implementation of the action strategies (i.e, Dedication, Elimination, and Combination) discussed in | TE

TC Table 4-61. Collective Cumulative Health Effects from Atmospheric and Liquid Releases for Alternative Actions at Existing Waste Sites

Component	No action	No waste removal and closure[a]	Waste removal at selected sites[a]	Waste removal and closure[a]
Atmospheric	2.9×10^{-2}	1.4×10^{-2}	1.4×10^{-2}	2.2×10^{-2}
Liquid	1.2×10^{-2}	1.2×10^{-2}	1.2×10^{-2}	1.2×10^{-2}
Combined	4.1×10^{-2}	2.6×10^{-2}	2.6×10^{-2}	3.4×10^{-2} [b]

TC

[a]Remedial actions taken at appropriate waste sites would reduce the tabulated health effects.

TC [b]Waste removal and closure result in comparatively higher cumulative health effects than either no-waste-removal and closure or waste removal at selected sites. This is because additional radionuclides could be set airborne from excavation performed during the year the waste removal and closure action is implemented.

Section 4.3 are insignificant. Because no atmospheric releases would result from implementation of any of the action strategies, the cumulative atmospheric component of the health effects would not be affected. Consequently, implementation of any of the waste storage facility alternatives would result TC in an insignificant change in the number of 4.1×10^{-2} health effects.

Disassembly-Basin Purge Water

Using the health risk estimator of 280 cancers and genetic effects per 1 million person-rem of collective dose, and the peak collective annual doses resulting from the three alternative strategies (excluding no action) for discharging disassembly-basin purge water (Section 4.4), calculations were made TE to determine the cumulative health effects that could be experienced by the population within an 80-kilometer radius of the SRP and the population using Savannah River water downstream from the SRP.

The change in the health effects resulting from each alternative is calculated by considering the peak annual dose of a 26-year study period. The rationale for considering a time range of 26 years is presented in Sections 2.4 and TC 4.4. The changes in these health effects, when combined with the no-action health effects given in Table 4-61, result in the cumulative annual health effects that could be experienced by the population after the implementation of the alternatives. These cumulative health effects are listed in Table 4-62.

Conclusion

Table 4-61 indicates that for the existing waste sites, the no-waste-removal-and-closure action and the waste removal at selected sites action result in the largest decrease in cumulative health effects.

Table 4-62. Collective Cumulative Health Effects from Atmospheric and Liquid Releases for Alternative Actions for Disassembly-Basin Purge Water Discharge — TC

Component	Combination Detritiation	Elimination Evaporation	Direct discharge	No action
Atmospheric	2.9×10^{-2}	2.9×10^{-2}	2.9×10^{-2}	2.9×10^{-2}
Liquid	1.2×10^{-2}	1.1×10^{-2}	1.4×10^{-2}	1.2×10^{-2}
Combined	4.1×10^{-2}	4.0×10^{-2}	4.3×10^{-2}	4.1×10^{-2}

TC

For the new retrievable-storage or waste disposal alternatives, there is no significant change in the cumulative health effects.

As indicated in Table 4-62, for the discharge of disassembly-basin purge water, evaporation is the only alternative that could result in a decrease in cumulative health effects when the collective doses are confined to the regional population. The direct-discharge alternative results in the highest cumulative health effects. TC

4.7.4.2 Exposure to Hazardous Substances

This section presents the cumulative health effects from exposure to hazardous substances. The majority of the cumulative health risks focus on the release of contaminants to the Savannah River with subsequent human exposure; however, because air and groundwater exposures could occur, they also are presented.

Existing Waste Sites

The Elimination strategy (waste removal at all sites) defines the lowest carcinogenic risk alternative for existing waste sites at the SRP as summarized in Table 4-63 for risks due to exposure via groundwater or surface water.

TC

Table 4-63. Carcinogenic Risks for Groundwater and Surface-Water Exposure (Elimination Strategy)

Exposure	Range of total risk (2085)		Range of maximum risk (year of occurrence)	
Groundwater	3.3×10^{-4} -	0	9.7×10^{-2} - (1997)	7.1×10^{-7} (2044)
Surface water	4.5×10^{-10} -	0	3.4×10^{-4} - (2026)	5.2×10^{-13} (2035)

TC

The maximum total risk associated with groundwater in 2085 occurs at the old TNX seepage basin. However, a maximum risk occurs at the CMP pits in 1997 due to the presence of tetrachloroethylene. By 2085, this risk would be reduced.

The maximum total risk for surface water in 2085 occurs at the CMP pits. The overall maximum risk is found at some of the burning/rubble pits (C- and CS-Areas). In 2026, the maximum risk would be due to the presence of trichloroethylene. These risks would be reduced by the year 2085.

TE Noncarcinogenic risks were also estimated. Most of the ratios of dose to ADI were less than 1, indicating little risk of noncarcinogenic (toxic) health effects. The ratio of dose to ADI did not exceed 1 in any surface waters and was usually less than 10^{-6}.

The air pathway was modeled through 2985 for both the exposed population and the maximally exposed individual. For the most part, individual health risks via the atmospheric pathway were low after implementation of the lower bound. Risks in a few areas were somewhat higher, but they decrease rapidly after 2085. These areas with high population risks include M-Area settling basin with an overall maximum risk of 2.34×10^{-3} in 2015, C-Area burning/rubble pit, and the old TNX seepage basin. Even where the risks to the population are highest, the risks for the maximally exposed individual are less than 10^{-8}. Individual risks apparently peak during site closure or waste removal activities, while the population risks peak in about 2085. After the site is reopened for habitation, risks rapidly reduce immediately and asymptotically approach zero.

New Retrievable-Storage Facilities

All new retrievable-storage facilities would be constructed to applicable (e.g., RCRA) regulations; therefore, no release of contaminants is expected. No adverse health effects are predicted.

Disassembly-Basin Purge Water

There are no releases of hazardous substances from current discharges or modifications of discharges of disassembly-basin purge water. Therefore, there would be no exposures or risks.

TE For the No-Action strategy, carcinogenic risks are somewhat higher than for the Elimination strategy. These risks are summarized in Table 4-64.

TC Table 4-64. Carcinogenic Risks for Groundwater and Surface-Water Exposure (No-Action Strategy)

Exposure	Range of total risk (2085)	Range of maximum risk (year of occurrence)
Groundwater	7.5×10^{-3} - 0	2.1×10^{-1} (1993) - 1.2×10^{-5} (2001)
Surface water	4.5×10^{-10} - 0	2.4×10^{-4} (2026) - 5.2×10^{-13} (2035)

TC

The maximum total risk associated with groundwater in 2085 would occur at the M-Area settling basin. However, a maximum risk would occur in 1993 due to the presence of tetrachloroethylene. By 2085, this risk is reduced by a factor of about 100.

The maximum total risk for surface water in 2085 would occur at the CMP pits. The overall maximum risk would be found at the burning/rubble pits. The maximum risk is 2.4×10^{-4} (which would occur in 2026), due to the presence of trichloroethylene. These risks are reduced by 2085.

Noncarcinogenic risks were also estimated. Most of the ratios of dose to ADI were less than 1, indicating little risk of noncarcinogenic (toxic) health effects. The ratio of dose to ADI did not exceed 1 in any surface waters and was usually less than 10^{-9}. Most potential noncarcinogenic health effects are associated with groundwater exposures (phosphate, nitrate, and mercury) in which the ratio of dose to ADI exceeds unity. TC

The air pathway was modeled through 2985 for both the exposed population and the maximally exposed individual. For the most part, individual health risks via the atmospheric pathway were low (less than 10^{-7}), even without remedial action. In a few cases, risks were somewhat higher, but they decrease rapidly after 2085.

Areas with high population risks include all the geographic areas except the Road A chemical basin. The maximum risks for the exposed population range from 3.4×10^{-3} to 1.4×10^{-4}. These peaks all occur in 1985 or 1986.

New Retrievable-Storage Facilities

All new retrievable-storage facilities would be designed and constructed to applicable (e.g., RCRA) regulations, and therefore no release of contaminants is expected. No adverse health effects are predicted.

Disassembly-Basin Purge Water

There are no releases of hazardous substances from current discharges or modifications of discharges of disassembly-basin purge water; therefore, there would be no nonradiological exposures or risks.

4.7.5 OTHER CUMULATIVE EFFECTS

This section discusses cumulative impacts from waste removal and closure at existing waste sites and the establishment of new retrievable-storage facilities, in conjunction with alternatives for disassembly-basin purge-water treatment and other existing or planned disposal and treatment facilities on the SRP. It also discusses additional cumulative impacts from offsite hazardous waste facilities and cumulative impacts affecting ecology, air quality, the socioeconomic structure, and archeological and historic resources.

4.7.5.1 Ecological

The Elimination strategy is not expected to have any aquatic ecological impacts, either directly or indirectly. At all existing sites, wastes would TC be removed, sites closed, and groundwater treated and released if required. New waste facilities would be designed on an essentially zero-release basis, so groundwater contamination would not occur.

Potential cumulative terrestrial impacts include the bioaccumulation of contaminants by plants growing in or near waste sites and the disruption of vegetation, wildlife, and their habitats. Because wastes would be removed from all existing waste sites under the Elimination strategy, the potential for bioaccumulation of contaminants by plants is insignificant. This also reduces the potential toxicological impact to wildlife that feed on the plants. Where new waste sites for retrievable storage of hazardous, mixed, or low-level wastes are proposed, land would be cleared and developed, disrupting existing vegetation, wildlife, and their habitats. The significance of these impacts cannot be determined until the areas to be disturbed are assessed ecologically. In terms of the overall SRP area, these land disruptions are insignificant. Disruption of wildlife would also occur due to the presence of human activities at existing and proposed waste sites. Such disruption would be of short duration at existing waste sites, and longer at new storage facilities.

No significant potential cumulative impacts to local wetlands are expected under the lower-bound alternative. Wetland communities on the SRP consist primarily of bottomland hardwood forests, with smaller acreages of cypress/tupelo, scrub/shrub, and emergent marsh communities (Jensen et al., 1982) along onsite streams and the Savannah River. Most waste sites are sufficiently removed from wetlands, and proposed remedial actions include erosion control measures. Significant impacts to wetlands are not expected to occur.

No potential impacts are expected to occur to threatened or endangered species, because no critical habitats or species have been found in the immediate vicinity of existing or proposed facilities.

TC Under the No-Action strategy, there is a potential for direct and indirect contamination of onsite streams, including the Savannah River. Based on the PATHRAE analysis performed for existing waste sites, particularly the radioactive waste burial ground and the F- and H-Area seepage basins, aquatic biota of Four Mile Creek could be affected adversely by concentrations of cadmium, chromium, lead, mercury, and tritium, because these are expected to exceed EPA aquatic biota criteria. Many onsite streams presently exceed these EPA criteria. The aquatic biota of these streams are probably being subjected to some stress under present conditions.

Potential cumulative terrestrial impacts under this alternative involve impacts to wildlife and vegetation that come into contact with contaminated waters and soils, which can result indirectly in a toxicological impact to wildlife if such plants are consumed. Wildlife can be impacted directly if they use standing contaminated waters at unfenced existing waste sites.

Potential minor impacts to wetlands could occur if contaminated waters in basins of existing waste sites overflow into nearby wetlands. The SRL seepage basins, the M-Area settling basin, and the old TNX seepage basin are near wetlands. Operation of the old TNX seepage basin has caused levels of mercury and gross beta to exceed the EPA aquatic biota criteria in the TNX swamp.

Onsite and Offsite Facilities

Onsite and offsite facilities include those cited in Sections 4.7.1.1 and through 4.7.1.4. The potential cumulative impacts to the environment from these facilities cannot be determined accurately, because little is known about their operations and releases. The Savannah River is presently above the aquatic biota criteria for lead, mercury, and silver, which is representative of existing water-quality conditions. Thus, aquatic biota of the river might already be subjected to stress as a result of all the facilities in the general area.

4.7.5.2 Air Quality

Air contaminants from potential sources other than the SRP are sufficiently distant that their effects on cumulative risk assessment would be negligible. Therefore, the risk assessments due to air releases discussed in Section 4.1 are considered applicable for cumulative effects for both onsite and offsite sources.

4.7.5.3 Socioeconomic

No more than 200 workers would be required for development of any of the proposed alternatives. Because these workers would be drawn from the existing construction workforce at the Plant, cumulative effects are expected to be negligible.

4.7.5.4 Archaeological and Historic Sites

No significant archaeological and historic sites have been identified at any of the existing waste sites or at any of the proposed alternative disposal/storage facilities. Therefore, the cumulative effects of implementing any of the alternatives are expected to be insignificant.

4.8 MITIGATION MEASURES

This section discusses mitigation measures that could reduce or offset potential environmental impacts and that are not part of the proposed action or alternatives (e.g., remedial action). Based on the identification of environmental consequences for the alternatives considered in the EIS, consideration might be given to the establishment of further programs to reduce radiological and nonradiological releases or to reduce potential ecological effects.

4.8.1 ENVIRONMENTAL CONSEQUENCES

The environmental consequences of the proposed action and alternatives are described fully in Sections 4.2, 4.3, and 4.4 for existing waste sites, new disposal facilities, and discharge of disassembly-basin purge water, respectively.

4.8.1.1 Existing Waste Sites

For the removal of wastes at selected existing waste sites, followed by closure and potentially required groundwater remedial actions (the preferred alternative), the environmental consequences, except for the No-Action strategy, during the 100-year institutional control period are largely beneficial. Health risk assessment and ecological impact modeling results generally are within or below acceptable ranges. Potential impacts to surface-water streams described in Section 4.7.5 are based on water-quality criteria that are nonenforceable concentration levels. Transient peak year health effects or established concentration standard (MCL) exceedances are fairly well defined and are postulated to occur briefly in groundwater (hypothetical wells) that is not currently used for onsite domestic supplies. Migration of these peak plume effects toward offsite receptors (i.e., the Savannah River) is predicted to occur in periods ranging from decades to centuries.

Through dilution or other physico-chemical or biological processes, it is reasonable to assume that order-of-magnitude reductions in health risk values or concentrations would occur. Modeling results for a 1000-year period have postulated these reductions. Implementation of short-term, immediate groundwater remedial actions would contain contaminated plumes, thereby preventing or reducing the extent of offsite migration of the plume.

Groundwater flow patterns mitigate any short-term migration of plumes to water supplies offsite. For example, the juncture of water-table aquifers in the northwest portion of the Plant with the deeper Middendorf/Black Creek or Congaree aquifers diverts the path of the potentially contaminated plumes TC through nearly a 90-degree change of flow direction that could result in ultimate discharge (after about 150 years) into the Savannah River or bordering swamps. Elsewhere on the Plant, water-table aquifers outcrop directly into onsite streams. Times of travel of plumes from seepage basins to outcrops vary from years to decades. Site dedication and exclusion ensure mitigation of potential environmental impacts well beyond the period of institutional control.

4.8.1.2 New Disposal Facilities

Construction and operation of new storage/disposal facilities under the preferred Combination strategy for hazardous, low-level radioactive, and mixed wastes that are designed to meet stringent regulatory requirements for essentially zero release would impose no permanent adverse impacts within the periods of operation (20 years), postclosure care, and monitoring during the 100 years of institutional control. Site dedication following closure would ensure maximum environmental protection in the long term.

4.8.1.3 Discharge of Disassembly-Basin Purge Water

Continuation of the discharge of disassembly-basin purge water to existing seepage and containment basins continues the current level of environmental releases and offsite doses of radioactivity.

4.8.2 MITIGATION MEASURES

4.8.2.1 Existing Waste Sites

Further mitigation of environmental consequences associated with the proposed action does not appear to be feasible with state-of-the-art technology.

However, many research and development studies are evaluating emerging technologies that show promise for future application. DOE would track these efforts to implement those technologies that offer future feasibility. The range of technologies should be directed toward the reduction of waste volumes, waste minimization through process charges, and the detoxification and destruction of retrievably stored hazardous wastes rather than toward an emphasis on permanent land burial or disposal. TC

The nature of radioactive waste, by contrast, does not lend itself to destruction or removal of the essential inherent radioactivity by direct physical, chemical, or biological means. Isolation, shielding, burial, and immobilization are currently the most reasonable alternatives for these wastes. Nevertheless, research and development efforts in the separation and fixation of radioactivity, particularly tritium, should be followed.

4.8.2.2 New Disposal Facilities

These facilities, by the nature of their design, would be essentially zero-release installations. Under the Combination strategy, as a mitigation measure, retrievable wastes would be available for future implementation of emerging technologies designed to destroy or detoxify hazardous, mixed, or low-level wastes.

4.8.2.3 Discharge of Disassembly-Basin Purge Water

Moderator detritiation through chemical or physico-chemical methods can be considered a mitigation measure. Other mitigative approaches that have been suggested are collection of tritiated groundwater at outcrops along surface streams and recycling of the water to seepage basins to allow another cycle of radioactive decay to occur; control of primary system heat-exchanger leakage; use of waste heat from various operations for barometric evaporation of tritiated streams; and vacuum evaporation with recovery.

4.9 UNAVOIDABLE/IRREVERSIBLE IMPACTS

4.9.1 STRATEGIES FOR EXISTING WASTE SITES

This section describes the adverse impacts of the strategies for the existing waste sites that cannot be avoided by reasonable mitigation measures. It also describes irreversible and irretrievable commitments of resources and short-term use and long-term productivity impacts of these strategies.

4.9.1.1 Unavoidable Adverse Impacts

Adoption of the No-Action strategy would result in the continued release of chemical and radionuclide contaminants from the existing waste sites. These releases are projected to result in contaminant concentrations in onsite groundwater and surface-water resources that exceed maximum contaminant levels established under the Safe Drinking Water Act. The groundwater contamination would occur at the following SRP areas: A, M, L, F, H, TNX, R, C, CS, K, P, and Road A. For surface-water resources, only nitrate and tritium in Four Mile Creek are expected to exceed maximum contaminant levels (Section 4.2.1 and Appendix F).

The carcinogenic and noncarcinogenic risks resulting from the release of non-radioactive chemicals have been calculated for the No-Action strategy. The maximum total carcinogenic risk at a well 100 meters downgradient from a waste site in 2085 (the year in which institutional site control is relinquished) would be 2.5×10^{-3} health effect per year at the M-Area settling basin. The maximum risk at a 100-meter well for tetrachloroethylene, the dominant carcinogenic chemical, would be 2.1×10^{-1} health effect per year in 1993 at the M-Area settling basin. The maximum total noncarcinogenic risk at a 100-meter well in 2085 would be 1.1×10^{2} times greater than the acceptable daily intake at the old TNX seepage basin. The maximum risk at a 100-meter well for nitrate, the dominant noncarcinogenic, would be 3.8×10^{2} times greater than the acceptable daily intake in 1991 at the M-Area settling basin (Section 4.1.1.6 and Appendix J).

The adverse health effects of the nonradioactive contaminants for the atmospheric pathway have been assessed for an exposed population and a maximally exposed individual. The maximum carcinogenic risk for the exposed population under the No-Action strategy would be 3.4×10^{-3} health effect per year in 1986 at the SRL seepage basins. The maximum carcinogenic risk for the maximally exposed individual would be 1.4×10^{-7} health effect per year in 2085 at the H-Area seepage basins. The maximum total noncarcinogenic risk for an exposed population would be 1.9×10^{1} times the acceptable daily intake in 2085 at the H-Area seepage basins. The maximum total noncarcinogenic risk for a maximally exposed individual would be 4.8×10^{-3} of the acceptable daily intake in 2085 at the H-Area seepage basins (see Section 4.2.1.6 and Appendix J).

The health risks associated with the release of radioactive contaminants under the No-Action strategy have also been determined. These health risks consist of radiation-induced cancers and genetic disorders. The cumulative health risks to the maximally exposed individual residing at the SRP boundary during 1985 and within the SRP site boundary during the peak year (2085) would be 9.8×10^{-7} and 3.9×10^{-4} health effects per year, respectively. The annual cumulative number of health effects imparted to the population in the SRP region, in 1985 and in 2085, would be 9.5×10^{-3} and 5.3×10^{-3} health effects per year, respectively (see Section 4.2 and Appendix I).

Adverse impacts to ecological resources could also occur under the No-Action strategy. Analyses indicate that Four Mile Creek could be affected adversely by concentrations of several contaminants that exceed EPA water-quality criteria for aquatic life. The use of open basins by aquatic organisms and terrestrial wildlife could also result in direct exposure to contaminants. The impacts associated with chronic exposures and potential biological accumulation are unknown. Wetland areas that are immediately adjacent to the SRL and M-Area seepage basins could also be affected by basin overflow during heavy rains (see Section 4.2 and Appendix F).

The closure and remedial actions that would occur under the strategies other than no action would reduce nonradioactive and radioactive contaminant releases via the groundwater, surface-water, and atmospheric pathways to within regulatory standards. Associated health effects would also be reduced from those anticipated under the No-Action strategy. However, adverse impacts could occur as a result of the implementation of closure and remedial actions.

Closure actions could include the backfilling of selected basins. Disruption of terrestrial habitats and effects on natural productivity could occur at the closure sites and other SRP areas from the creation of new or the expansion of existing borrow pits for backfill materials. Also, these operations would have associated occupational risks. Remedial action could include groundwater withdrawal and treatment at selected sites. Groundwater withdrawal would result in the drawdown of water-table aquifers. However, this drawdown would be small and localized and would not affect SRP drinking-water wells. The effluent from the groundwater treatment facilities could be discharged to local onsite streams. The subsequent increased flows in the receiving streams could cause changes in their ecologic structure. Further study would be required to quantify the potential impacts from closure and remedial actions.

4.9.1.2 Irreversible and Irretrievable Commitments of Resources

Resources that would be irreversibly and irretrievably committed during the implementation of the existing waste site strategies include (1) materials that cannot be recovered or recycled and (2) materials consumed or reduced to unrecoverable forms. For the actions under consideration, irretrievable resource use would include contaminated materials and equipment that could not be reused and energy consumed during the closure and remedial actions. However, the current level of planning for the existing waste site strategies does not permit a quantification of these resource consumption rates.

4.9.1.3 Short-Term Uses and Long-Term Productivity

The short-term effects of the existing waste site strategies would include the loss of upland sites for their natural productivity. The amount of uplands required for borrow pits and remedial actions has not been determined but would be expected to be minimal. In the long term, the natural vegetation at these sites could become reestablished through the process of natural succession. In addition, the land (about 300 acres) associated with certain waste sites would remain dedicated to waste disposal under the No-Action strategy.

4.9.2 STRATEGIES FOR NEW DISPOSAL FACILITIES

This section describes the adverse impacts of the strategies for the new disposal facilities that cannot be avoided by reasonable mitigation measures. It also describes irreversible and irretrievable commitments of resources and short-term use and long-term productivity impacts of these strategies.

4.9.2.1 Unavoidable Adverse Impacts

Construction and operation of new disposal facilities would impact undeveloped upland areas on the SRP. The clearing of this land could be expected to result in the loss of wildlife habitat, the loss of animals with limited home ranges, and the redistribution of more mobile species. The land requirements for new disposal facilities would require a maximum of about 400 acres.

There will be an unavoidable contribution to the radiological dose received by individuals who are downstream Savannah River water users and by persons living on the SRP site following institutional control. Based on conservative modeling and summation of peak doses, the downstream contribution amounts to dc

less than one ten-thousandth of the 4 millirem per year drinking-water dose standard. For onsite residents (after institutional control) doses would be higher but are still expected to remain well under the 4 millirem/year standard. Radiological doses under the No-Action strategy were not modeled but could result in substantially higher values in the event of a large accidental release.

Under the No-Action strategy, wastes would continue to be disposed of in existing facilities until the capacities of these facilities had been attained. After that, the wastes would be stored onsite in the safest manner possible without the construction of new facilities. The release of hazardous or radioactive constituents and the associated health and environmental effects would be insignificant as long as no leaks or spills occurred. However, because the release-containment systems required in RCRA and Atomic Energy Act (AEA) facilities would not be present at the no-action facilities, the risk of serious accidental release would be much greater than for any of the other strategies.

4.9.2.2 Irreversible and Irretrievable Commitments of Resources

Resources that would be irreversibly and irretrievably committed during the implementation of the new disposal facilities include materials that cannot be recovered or recycled, and materials consumed or reduced to unrecoverable forms. For the actions under consideration, irretrievable resources would include contaminated materials and equipment that could not be reused and energy consumed during the construction and operation of the facilities. However, the current level of planning for the new disposal facilities does not make it possible to quantify these resource-consumption rates.

4.9.2.3 Short-Term Uses and Long-Term Productivity

In the short term, the construction and operation of the facilities would affect up to 400 acres of uplands. Over the long term, upland vegetation could become reestablished through the process of natural succession only with the Elimination strategy. For the Dedication and Combination strategies, the associated land would remain dedicated to waste disposal.

4.9.3 STRATEGIES FOR DISCHARGE OF DISASSEMBLY-BASIN PURGE WATER

Four strategies are considered for the discharge of disassembly-basin purge water: No-Action, Dedication, Elimination, and Combination. They are discussed in detail in Sections 2.4 and 4.4. This section discusses impacts associated with the strategies that could not be avoided by reasonable mitigation measures. It also discusses irreversible and irretrievable commitments of resources, short-term uses, and long-term environmental implications.

4.9.3.1 Unavoidable Adverse Impacts

The discharge of disassembly-basin purge water would lead to unavoidable radiation exposure to man, regardless of which strategy is implemented. These exposures would be negligible in comparison to those associated with natural background radiation. Section 4.4 presents the estimated radiation exposures to man associated with each strategy.

4.9.3.2 Irreversible and Irretrievable Commitments of Resources

Resources that would be irreversibly and irretrievably committed with the implementation of a particular strategy include materials that cannot be recovered or recycled, and materials consumed or reduced to unrecoverable forms. The implementation of a particular strategy would require irretrievable commitments of energy. The actual amount of committed energy required would depend on the final engineering design. Small amounts of radioactive waste could require land commitment for final disposal.

4.9.3.3 Short-Term Uses and Long-Term Productivity

Short-term effects of waste management operation include the unavailability of site areas for natural productivity and wildlife habitat. Detritiation would require the greatest site area, with the construction of the moderator detritiation plant. The implementation of evaporation would also require a relatively large commitment of area for either the construction of an evaporation pond or the installation of commercial evaporators. Direct discharge would require only the area needed to pipe water from the reactors to onsite streams. No action would require the commitment of the seepage basins currently in use. Following decommissioning and decontamination, the area could revert to its natural state with minimal long-term effects.

4.10 PREFERRED ALTERNATIVE WASTE MANAGEMENT STRATEGY

4.10.1 RATIONALE FOR SELECTION

DOE has identified the Combination waste management strategy as its preferred alternative. This strategy provides compliance with applicable environmental regulations (RCRA, Hazardous and Solid Waste Amendments of 1984, and South Carolina Hazardous Waste Management Act) and DOE guidelines through combinations of site dedication, elimination of selected waste sites, and storage and disposal of hazardous, low-level radioactive, and mixed wastes. DOE's preferred waste management strategy is based on lower tier project-level actions, including removal of wastes at selected existing waste sites; remedial and closure actions at existing waste sites, as required; the construction of retrievable storage and aboveground or belowground disposal facilities for hazardous, mixed, and low-level radioactive wastes; and the management of periodic discharges of disassembly-basin purge water from C-, K-, and P-Reactors by discharging filtered, deionized disassembly-basin purge water to active reactor seepage and containment basins.

4.10.1.1 Existing Waste Sites

The primary considerations in choosing the preferred waste management strategy are the reduced environmental effects and occupational risks from remedial and closure actions, the cost of remedial and closure actions, the capacity and cost of new storage and disposal facilities, and the amount of land, if any, that would be dedicated to waste management at the end of the institutional control period.

4.10.1.2 New Disposal Facilities

The preferred strategy would apply a combination of retrievable storage and aboveground or belowground disposal technologies to optimize the management of wastes with different characteristics within the hazardous, mixed, and low-level radioactive waste streams generated at the SRP. The implementation of this strategy would comply with the requirements of RCRA, HSWA, SCHWMA, and DOE Orders.

The Combination strategy for the construction of new storage and disposal facilities for the management of hazardous, mixed, and low-level radioactive waste consists of:

TE
1. Buildings for retrievable storage of selected wastes of all three types

2. RCRA landfill or vaults for the disposal of hazardous waste

TC
3. RCRA landfills or vaults, including or not including CFM vaults, for the disposal of mixed waste

4. ELLTs, vaults, or AGOs for the disposal of low-activity radioactive wastes

5. Vaults or GCD for the disposal of intermediate-activity, low-level radioactive wastes.

TC
Optional technologies in Items 2 and 5 are considered equivalent in terms of groundwater protection capabilities. Options that include CFM vaults in Item 3 and ELLTs in Item 4 were selected to represent the minimium or least protective technology in their waste management roles. The environmental impacts of the Combination strategy lie within each of the categories listed. No preference has been determined among technologies, although DOE is placing emphasis on the concept and use of vaults.

4.10.1.3 Discharge of Disassembly-Basin Purge Water

The Combination strategy includes the continued discharge of disassembly-basin purge water to active reactor seepage and containment basins and the pursuit of studies to assess reactor moderator detritiation or other mitigation measures. This EIS discusses moderator detritiation to provide an estimate of costs and a description of beneficial or mitigative impacts.

4.10.2 ADVANTAGES

4.10.2.1 Existing Waste Sites

TC
Waste removal at selected sites, closure, and remedial actions would have lower costs, insignificant ecological effects, and fewer occupational risks than full-scale waste removal and closure actions and would require less storage and disposal capacity. At the sites tentatively selected for waste removal, the concentrations and extent of constituents in the groundwater that are above regulatory standards could be reduced significantly. Only a small

fraction of SRP land would require dedication for waste management purposes at the end of the institutional control period.

4.10.2.2 New Disposal Facilities

The advantages of the preferred strategy are:

- Waste disposal would be permanent.
- Disposal would comply with applicable regulations.
- Facilities would comply with environmental standards.
- Storage of wastes would comply with applicable regulations, assuming waivers on long-term storage would be granted.
- A mix of disposal and storage technologies could be selected to optimize performance and minimize cost.

TC

4.10.2.3 Discharge of Disassembly-Basin Purge Water

The continued discharge of disassembly-basin purge water to seepage basins and the continued assessment of tritium-mitigation measures, such as reactor moderator detritiation, result in the lowest off-site doses and allow for continued evaluation of future mitigation options. Annual off-site doses due to tritium could be reduced substantially. No additional costs or equipment for continued discharge are required. TC

4.10.3 DISADVANTAGES

4.10.3.1 Existing Waste Sites

The primary disadvantage of the preferred strategy is that dedication for waste management purposes would be required for those sites in which waste was not removed and that could not be returned to public use after the institutional control period.

4.10.3.2 New Disposal Facilities

The disadvantages of new disposal facilities are twofold:

- The high cost of construction and operation, some land dedication, and grouting of waste packages could make retrieval difficult in the event it became necessary.
- Additional costs would be required in future for treatment and disposal of wastes placed in retrievable storage.

4.10.3.3 Discharge of Disassembly-Basin Purge Water

TC

A disadvantage of mitigation of tritium releases is the continued contamination of shallow groundwater resources. A long lead time is associated with continued studies and implementation of feasible measures. Optimistic estimates for detritiation to reach its full potential range from 5 to 10 years.

4.10.4 ENVIRONMENTAL IMPACTS

4.10.4.1 Groundwater

Existing Waste Sites

The implementation of the preferred strategy at selected existing waste sites, plus closure and remedial actions as required, would reduce onsite groundwater contaminant concentration levels to meet applicable standards. Potential drawdown effects in water-table aquifers would be localized and transitory and would be observed throughout groundwater remedial actions that employed recovery wells or groundwater pumping.

New Disposal Facilities

All new disposal and storage facilities would be designed for essentially zero or ALARA releases. No significant adverse groundwater effects are expected as a result of the implementation of the preferred strategy.

Discharge of Disassembly-Basin Purge Water

The continued discharge of disassembly-basin purge water to active reactor seepage and containment basins would maintain the current level of effects to groundwater. An assessment of mitigation measures for tritium releases, such as reactor moderator detritiation, could result in the establishment of feasible technologies in the future that would reduce tritium concentrations.

4.10.4.2 Surface Water

Existing Waste Sites

The implementation of the preferred alternative could result in an improvement of surface-water quality. Waste removal, closure, and remedial activities, if required, would reduce the level of surface-water contaminant concentrations to regulatory limits or below.

New Disposal Facilities

No significant impacts to surface-water quality are expected with the implementation of the preferred alternative strategy. The goals of RCRA (i.e., essentially no releases from hazardous or mixed waste facilities) and the ALARA concept for low-level radioactive waste facilities would ensure insignificant levels of impact.

Discharge of Disassembly-Basin Purge Water

Existing surface-water effects from groundwater outcrops of reactor seepage basin subsurface flows would continue. Travel times vary from 4 to 11 years, allowing for partial radioactive decay of the tritium (12.3-year half-life). Transport modeling indicates there is little lateral dispersion of migrating tritium in these paths. Detritiation or other mitigation measures, if applicable, would result in a reduction of tritium concentrations in onsite streams.

4.10.4.3 Health Effects

Existing Waste Sites

The implementation of the preferred alternative would result in no increase in health effects with waste removal, closure, and remedial actions at existing waste sites.

New Disposal Facilities

Essentially zero release and the ALARA design would prevent radionuclide and hazardous chemical health effects.

Discharge of Disassembly-Basin Purge Water

No significant health effects would occur as a result of the continued discharge of disassembly-basin purge water to active reactor seepage and containment basins.

4.10.4.4 Ecology

Existing Waste Sites

The removal of wastes at selected sites and closure and remedial actions, as required, would reduce potential aquatic impacts as a result of the implementation of the preferred alternative strategy. Terrestrial impacts that result from direct exposure to open waste sites and groundwater-associated impacts would be eliminated by waste removal at selected sites and closure and remedial actions as required. The use of borrow pits for backfill in closure actions would create minor short-term terrestrial impacts.

New Disposal Facilities

No aquatic impacts are expected from the implementation of the preferred strategy for new disposal and storage facilities. The strategy would result in minor short-term impacts from the clearing and development of land. No contaminant-related terrestrial impacts are expected, due to zero release or ALARA designs of new facilities.

Discharge of Disassembly-Basin Purge Water

Minor aquatic impacts would continue, as at present, under continued or mitigated discharge to active reactor seepage and containment basins. No significant terrestrial ecological impacts are expected.

4.10.4.5 Other Impacts

Existing Waste Sites

Short-term disruptions of habitats could occur at borrow pit areas. Some waste sites could require erosion-control measures during site-closure activities. No impacts are expected to endangered species, archaeological and historic sites, or socioeconomic resources, or from noise as a result of the implementation of the preferred strategy.

New Disposal Facilities

Construction of disposal and storage facilities for the preferred strategy would result in a loss of habitat totaling up to 400 acres, or about 0.2 percent of the entire SRP natural area. No impacts are expected for endangered species, socioeconomic resources, nor are any noise-related impacts anticipated. One candidate waste-disposal site would require an additional archaeological survey.

Discharge of Disassembly-Basin Purge Water

No significant impacts to habitats or wetlands are expected from the implementation of the preferred strategy. Endangered species, archaeological and historic sites, and socioeconomic resources would not be impacted, nor would there be noise-related impacts.

4.10.5 ACCIDENTS AND OCCUPATIONAL RISKS

4.10.5.1 Existing Waste Sites

Waste removal and transport to storage and disposal sites by vehicles involve the risks of fires, spills, leaks, and exposure of onsite workers. These are short-term risks, occurring only during waste-removal activities.

4.10.5.2 New Disposal Facilities

High-integrity containers, spill recovery, and other secure provisions would reduce contaminant-related impacts from accidents. Long-term handling of wastes (20-year estimated facility lifetimes) requires strict control measures.

4.10.5.3 Discharge of Disassembly-Basin Purge Water

No significant occupational risks are associated with the preferred alternative.

4.10.6 SITE DEDICATION

4.10.6.1 Existing Waste Sites

Sites from which waste was removed could be returned to public use after the 100-year institutional control period. Sites from which waste was not removed would be dedicated for waste management purposes if they could not be returned to public use.

4.10.6.2 New Disposal Facilities

New disposal facilities would be dedicated for waste management purposes. Up to 400 acres, including buffer zones, would be required, except for the retrievable-storage-facility portion, which could be returned to public use after wastes had been removed to permanent disposal facilities.

4.10.6.3 Discharge of Disassembly-Basin Purge Water

Seepage and containment basins would be dedicated as needed due to the continued discharge of disassembly-basin purge water to these basins. The implementation of feasible mitigation measures would allow DOE to discontinue the use of the basins and evaluate actions to return them and their surrounding areas to public use after the 100-year institutional control period.